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Supervisory Control System for Ship Damage Control: Volume 5 — Knowledge Ontology

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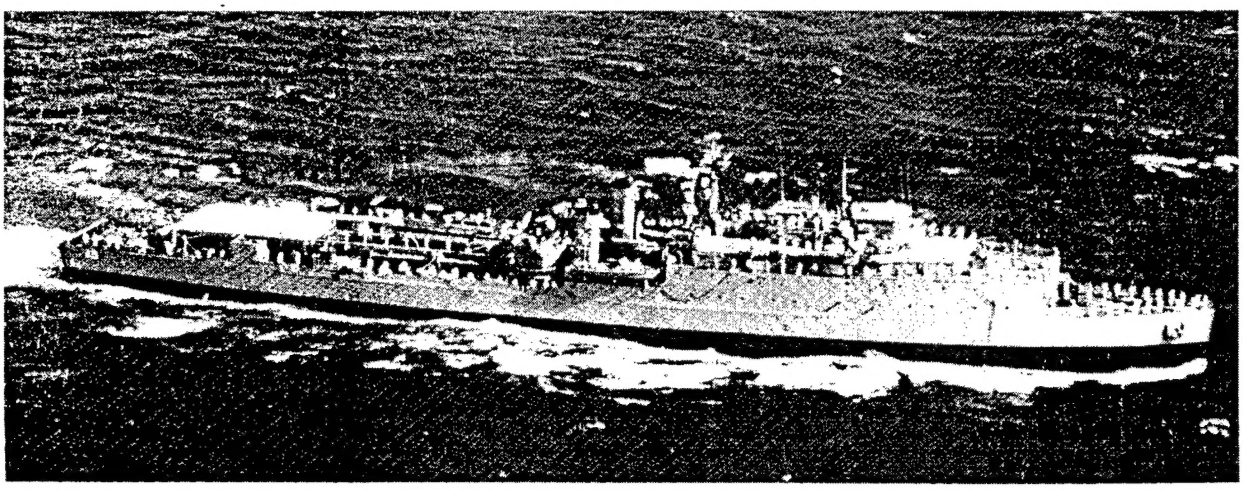

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Ontology is a formal representation of knowledge—in this case, the knowledge necessary to encapsulate the state of a ship and its simulation at any given time. This knowledge ontology described in this report is relevant to Navy ships in general and damage control in particular.

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SUPERVISORY CONTROL SYSTEM FOR SHIP DAMAGE CONTROL:

VOLUME 5 – KNOWLEDGE ONTOLOGY

1. Introduction

Ontology is a formal representation of knowledge—in this case, the knowledge necessary to encapsulate the state of a ship and its simulation at any given time. This knowledge ontology described in this report is relevant to Navy ships in general and damage control in particular.

This ontology is currently relevant to three research projects at the University of Illinois related to ship damage control. These are the Damage Control – Supervisory Control System (DC-DCS) for the Damage Control – Automation for Reduced Manning (DC-ARM) program at the Naval Research Lab (NRL); the Damage Control – Trainer (DC-TRAIN) project sponsored by the Office of Naval Research (ONR) for training Navy officers at the SWOS Navy officer school; and a Stanford-Illinois Multi-Disciplinary University Research Initiative (MURI) in the area of natural language dialogue, sponsored by DoD. The research prototypes associated with these three research projects all are able to make use of the knowledge ontology described herein for finding out the state of the world and for sub module communication.

This report is intended to document various aspects of damage control terminology for internal orientation as well as to provide a description of a system for completely representing the nature and state of a ship in database form.

The organization of this report is as follows. Chapter 2 covers some basic domain terms. Chapter 3 describes the canonical system of compartment naming and explains our internal adaptive techniques. Chapters 4 through 7 detail the organization of the database and the table structures. Chapter 8 provides a description of the internal event communication language while Chapter 9 covers the current event communication language. Chapter 10 discusses future ideas on the handling of event communication.

2. Basic Terminology

2.1 Bow

The bow is the front of the ship.

2.2 Stern

The stern is the back of the ship.

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2.3 Fore/Forward

When you're standing on the ship, fore is toward the bow. Fore is a direction, not a location. Fore is the opposite direction from aft.

2.4 Aft

When you're standing on the ship, aft is toward the stern. Aft is a direction, not a location. Aft is the opposite direction from fore.

2.5 Port

When you're standing on the ship facing the bow, port is to your left. If you're facing the stern, port is on your right. Port is a direction relative to the ship's orientation, as in "Hard (turn) to port!" Port is the opposite direction from starboard.

2.6 Starboard

When you're standing on the ship facing the bow, starboard is to your right. If you're facing the stern, starboard is on your left. Starboard is a direction relative to the ship's orientation, as in "Hard [turn] to starboard!" Starboard is the opposite direction from port.

2.7 Waterline

Like many others, the LSD class of ship is expected to float on the water during normal operation. The waterline is where the top of the water meets the ship.

3. Compartment Nomenclature

The Navy refers to "rooms" aboard a ship as compartments. Each compartment has a unique identifier, composed of the following parts.

3.1 Deck

Technically, a deck is a horizontal platform that separates one level from another. A compartment is then said to be on a particular deck if the floor of the compartment is a section of that deck. Compartments that span multiple decks are therefore named after the lowest deck of which they are a part. Decks above the waterline are numbered with an initial 0. Decks increase in number as you move away from the waterline; on the LSD15, for instance, the bottommost deck is 4 and the highest 04.

3.2 Frame

The term `frame' is used to denote both a dimension of measurement as well as a physical part of the ship. Conceptually, frames are vertical slices of the ship from port to starboard. Physically, a frame is any vertical wall that runs from port to starboard. Frames have a number corresponding to their distance from the foremost point of the ship's bow. The

increments of the frame numbering correspond to a unit of measure, which is approximately 4 feet on the ex-USS *Shadwell.*

A compartment is said to be on a particular frame if the foremost wall of the room is a wall at that frame.

3.3 Position

The position indicates the relation of a compartment to the centerline of the ship. A position number of 0 represents the centerline of the ship; increasing even numbers represent increasing distance port of center, while odd numbers represent increasing distance starboard of center. The position numbers coordinate with the frame numbers to provide a unique identifier: two compartments on the same deck and frame will not have the same position number. Certain special compartments (often a passageway that wraps around several others) will have a position number that starts with a zero.

3.4 Type

The type of a compartment is designated by a single character, which represents how the compartment is used, as described in the Table .

Code	Type of Room
A	General Storage
C	Command and Control
E	Engineering Machinery
F	Fuel Tanks
G	Gasoline Storage
J	JP-5 Storage
K	Chemical Storage
L	Living Areas
M	Ammunition Storage
Q	Miscellaneous
T	Vertical Access Trunks
V	Void
W	Water Tanks

3.5 Navy Compartment Identifiers

Each compartment on a ship can therefore be referred to by a unique four-part designation comprised of the components mentioned above: the deck number, frame number, position number, and usage designation, connected by hyphens (pronounced "tac"). The result is the canonical compartment .

The usage designation is for informational purposes only – it never serves to distinguish one compartment from another – so it is often discarded internally. For interface/training purposes, however, it is a required part of the identifier.

3.6 KBS-Internal Compartment Identifiers

In our system, we need to perform comparisons on various compartments. The Navy compartment ID would be fine if it remained one continuous text string. However, there are times when the system needs to reason about the subparts of a designation, which is problematic with the given notation.

For example, decks 3 and 03 are separate decks with several decks between them, but when the strings "3" and "03" are converted into integers, the same number results. The same happens to positions "1" and "01".

We use a different notation within our system so that our modules can process this information without continuously performing complex conversions. This system was designed to convert every Navy compartment ID into a new ID which remains unique within the ship, requires less conversion within the various modules, and is easy for humans to convert back and forth at a glance. Under our system, all compartment Ids consist of the following format: integer tac positive integer tac positive integer. The algorithm is as follows:

1. Convert deck numbers with leading zeroes (like 01, 02) to the corresponding negative numbers (-1, -2). Leave other deck numbers unchanged.
2. Convert position numbers with leading zeroes by removing the zeroes and multiplying by 100. Position 01 becomes 100 and 02 becomes 200.
3. Drop the usage designation.

For example, the Navy compartment ID 01-110-01-Q becomes –1-110-100.

In addition, frame 9999 is a special notation without a direct Navy equivalent. Frame 9999 designates all the compartments on a particular deck in contexts where the compartments do not need to be listed individually, and is used internally for passing certain messages. For example, "-1-9999-0" would be the KBS notation for designating all compartments on the 01 level.

4. Database Organization

4.1 Repository

Currently, the latest version of the database is located at

\\Odyseeus\Teamwork\FullSystem\Ontology\AndDatabase\

4.2 Organizational Strategy

The table in the database can be divided into five main categories: static simulation (described in chapter 5), dynamic simulation state (described in chapter 6), *Shadwell* specific tables (described in chapter 7), and internal communication (described in chapter 8).

5. Static Ship Structure

Static ship structure tables are those that describe various aspects of the structural layout of the ship: they will not change during the simulation, but do depend on the ship being simulated.

5.1 Candidate Fire Boundaries

A list of frames reinforced enough to use for fire boundaries.

Name*	Type	Size	Notes
Deck	Number (Long)	4	KBS deck number
Frame	Number (Long)	4	KBS frame number

*Used by Agents.

Used by DCTMessageBlank (HCI) during initialization. Available through HCI by clicking on fire->order->fire boundaries. This table is empty for *Shadwell.*

5.2 Compartment Adjacency

Describes the connectivity of the ship's compartments.

Name*	Type	Size	Notes
CompartmentID	Text	50	KBS Name of compartment
Neighbor	Text	50	KBS name of neighbor
Direction	Text	50	Cardinal direction

*Used by Intelligent Agents.

This information can be seen indirectly through the visualization of the ship. There are no values for this for *Shadwell.* The reason there are no values is because this table was replaced by a new design of the wall table where compartment adjacency can now be found.

5.3 Compartment Alarms

Describes the alarms installed on the ship.

Name*	Type	Size	Notes
AlarmID	Number (Long)	4	Serial number
Type	Text	50	Description
CompartmentID	Number (Long)	4	Foreign key on Compartments

*Used by Intelligent Agents.

When a compartment alarm goes off the visualization will blink the compartment in which the alarm is. Currently empty for *Shadwell.*

5.4 Compartment Content

This table is used to represent the amount of fire-propagating items in a compartment. Certain items spread fire faster than others, and those items will have a higher

ContentAmount. For instance a container of fuel is much more serious to have near a fire than a chair would be; thus, the container of fuel will have a higher ContentAmount. This information can be used for intelligent reasoning over which compartments are more important than others to stop a fire from getting to, also for ship simulation to more accurately handle fire propagation. This table is a summary by compartment of the information that would be found in CompartmentContentList.

Name*	Type	Size	Notes
CompartmentID	Number (Long)	4	Foreign key on Compartments
ContentID	Number (Integer)	2	
ContentAmount	Number (Single)	4	
SuppressedAmount	Number (Single)	4	

*Used by simulation during initialization.

This information is not currently available through the interface. Currently there is only the ContentAmount specified for each CompartmentID for *Shadwell*.

5.5 Compartment Item Types

Describes the types of items that can be found in compartments. This information is used by the physical simulation module to aid in estimating the fuel present in the compartment for purposes of fire propagation. Each entry in this table is identified with a different set of parameters for the simulator. In general, this table is mainly an index to the following table, Compartment Content List.

Name*	Type	Size	Notes
ItemTypeID	Number (Integer)	4	Serial Number
ItemName	Text	50	Description

*Used by visualization during initialization.

This information is not currently available through the interface. This table has some initial values.

5.6 Compartments

Each compartment is identified by a quadruple <deck, frame, position, type>. This table translates between several compartment identification schemes. "Bogus" compartments are those that do not exist on the DC plates: they are used either to enable visualization to draw elements like the ship's antenna, or to model elements like the outside environment.

Name*	Type	Size	Notes
CompartmentID	Number (Long)	4	Serial number
Name	Text	50	Full Navy ID (i.e. 01-110-01-Q)
Deck	Number (Long)	4	KBS Deck number (i.e. –1)
Frame	Number (Long)	4	KBS Frame number (i.e. 110)
Position	Number (Long)	4	KBS Position number (i.e. 100)
Type	Text	1	Type designator (i.e. Q)
Description	Text	100	(i.e. Tech Library Annex)
KBSName	Text	50	Full KBS ID (i.e. –1-110-100)
IsBogus	Yes/No	1	Marks "fake" compartments

*Used by Agents and DCTInterface (HCI).

Used by Visualization, Simulation, and DCTMessageBlank (HCI) during initialization. Used by Bayesian Classifier, read-only. The compartments can be seen in the visualization and are listed as choices in various areas of the interface. Currently populated with static information.

5.7 Compartment Contents List

Describes the contents of each compartment. Each row in this table represents the count of a single type of item in a single compartment. For example, if a certain compartment contains ten units of bedding, three units of electronics, and four units of ammunitions there would be three entries in this table keyed to that compartment.

Name	Type	Size	Notes
ItemTypeID	Number (Integer)	2	Foreign key on CompartmentItemTypes
ItemCount	Number (Long)	4	Number of that item
CompartmentID	Number (Long)	4	Foreign key on Compartments

Not currently used or represented in the interface. Currently empty .

5.8 Correct Fire Boundaries

Lists appropriate settings for fire boundaries to handle listed compartment

Name	Type	Size	Notes
Deck	Number (Integer)	2	KBS Deck number
Frame	Number (Integer)	2	KBS Frame number
Position	Number (Integer)	2	KBS Position number
SecAft	Number (Integer)	2	Secondary aft fire boundary
PriAft	Number (Integer)	2	Primary aft fire boundary
PriFore	Number (Integer)	2	Primary fore fire boundary
SecFore	Number (Integer)	2	Secondary fore fire boundary

This information is not currently available through the interface. Empty for *Shadwell.*

5.9 Detailed Compartment Adjacency

This table breaks out the compartment ID's into their components; it serves the same function as Compartment Adjacency.

Name*	Type	Size	Notes
Deck-1	Number (Single)	4	1st KBS Deck
S_Generation	Number (Long)	4	
S_GUID			
S_Lineage			
Frame-1	Number (Integer)	2	1st KBS Frame
Position-1	Number (Integer)	2	1st KBS Position
Type-1	Text	1	1st KBS Type
Direction	Number (Integer)	2	Nature of adjacency
Deck-2	Number (Single)	4	2nd KBS Deck
Frame-2	Number (Integer)	2	2nd KBS Frame
Position-2	Number (Integer)	2	2nd KBS Position
Type-2	Text	1	2nd KBS Type

*Used by Agents.

This information is only indirectly available through the visualization. Empty for *Shadwell.*

5.10 Doors

This table characterizes the doors on the ship with regard to their position within the containing wall. Doors with type –1 are internal to a compartment; other doors connect compartments.

Name*	Type	Size	Notes
DoorID	Number (Long)	4	Serial number
WallID	Number (Integer)	2	Foreign key on Walls
CenterX	Number (Integer)	2	
CenterY	Number (Integer)	2	
CenterZ	Number (Integer)	2	
Width	Number (Single)	4	[ft]
Height	Number (Single)	4	[ft]
Name	Text	50	Canonical Navy ID
Type	Number (Long)	4	(see DC Plate 3)

*Used by Agents.

Used by Simulation and Visualization during initialization. Doors can be seen as yellow spheres in the ship visualization. Contains static information for *Shadwell.*

5.11 Electrical System Nodes

This table contains the layout of the electrical system. Nodes with an ID of 101-199 are generators, 201-299 switchboards, 301-399 load centers, and 1001- loads.

For the frequency columns, some values have special meanings. In general a frequency value of 0 indicates direct current. A source frequency of –1 indicates that the node produces its own power, while an output frequency of –1 indicates that the node drains to the ground.

Name*	Type	Size	Notes
NodeId	Number (Long)	4	Numeric identifier
Handle	Text	50	Internal name
Name	Text	50	Canonical Name
Compartment	Text	50	Deprecated
CompartmentId	Number (Long)	4	Foreign key on Compartments
SourceFrequency	Number (Long)	4	[Hz]
OutputFrequency	Number (Long)	4	[Hz]

*Used by Agents and DCTInterface (HCI).

Used by DCTMessageBlank during initialization. May be used by Visualization in the future. This information is not currently available through the interface. Empty for *Shadwell.*

5.12 Fire Main Nodes

The fire main is modeled as an undirected graph; this table describes the nodes of the fire main. A node is anything that can affect flow within the fire main system: valves, junction, narrowings, widenings, gauges, and pumps, for instance. The handle fields are used to describe certain kinds of connection info, as any given node may only be the endpoint of at

most three edges. So an end node, like a sprinkler, will only connect to one edge; this edgeID is stored in HandleOne. A node connecting two edges (like an elbow joint) will have values for HandleOne and HandleTwo. For a node incident to three edges (like a T-junction), all three handles will contain the ID's of the incident edges. Any unused handles will contain –1 as their value.

Name*	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	Foreign key on Fire MainPipes
HandleTwo	Number (Long)	4	Foreign key on Fire MainPipes
HandleThree	Number (Long)	4	Foreign key on Fire MainPipes
InSea	Yes/No	1	
CompartmentID	Number (Long)	4	Foreign key on Compartments
VertexType	Text	50	Describes the nature of node
Name	Text	50	Navy ID (valves only)

*Used by Agents and DCTFire Main (HCI).

Used by Visualization, Simulation, and DCTMessageBlank (HCI) during initialization. Some of this information can be seen indirectly by the user who can change the status on certain types of fire main nodes. The fire main can also be seen in the visualization. Static information for *Shadwell.*

5.13 Fire Main Pipes

This table lists the edges of the fire main graph; by default flow is from head to tail.

Name*	Type	Size	Notes
PipeID	Number (Long)	4	Serial number
HeadNodeID	Number (Long)	4	Foreign key on Fire MainNodes
TailNodeID	Number (Long)	4	Foreign key on Fire MainNodes
CompartmentID	Number (Long)	4	Foreign key on Compartments
Diameter	Number (Single)	4	[ft]

*Used by Agents.

Used by Simulation and Visualization during initialization. This information can be seen in the visualization with the rest of the fire main. Static information for *Shadwell.*

5.14 Fuel Description

This table is used to hold important information about the different types of fuel that would be present on the ship.

Name*	Type	Size	Notes
Identifier	Number (Integer)	2	Foreign key on ReactionProperties
FuelName	Text	50	
UnitFuelConsumingRate	Number (Double)	8	Kg/s
CompleteFuelHeatCapacity	Number (Double)	8	J/kg
IncompleteFuelHeatCapacity	Number (Double)	8	J/kg
FuelBasicSootCapacity	Number (Double)	8	Kg
FuelIncompleteSootCapacity	Number (Double)	8	Kg
MolarMass	Number (Double)	8	Kg

*Used by Simulation during initialization.

This information is not currently available through the interface.

5.15 Hatches

Hatches are openings in decks and ceilings; this table is otherwise identical to the Doors table.

Name*	Type	Size	Notes
HatchID	Number (Long)	4	Serial number
WallID	Number (Integer)	2	Foreign key on Walls
CenterX	Number (Integer)	2	
CenterY	Number (Integer)	2	
CenterZ	Number (Integer)	2	
HatchWidth	Number (Single)	4	[ft]
HatchHeight	Number (Single)	4	[ft]
Name	Text	50	Canonical Navy ID
Type	Number (Long)	4	(see DC Plate 3)

*Used by Agents.

Used by Simulation and Visualization during initialization. Hatches can be seen in the visualization as green spheres. Contains static information for *Shadwell*.

5.16 Manned or Umanned

Lists manned/unmanned status of each compartment.

Name*	Type	Size	Notes
CompartmentID	Text	50	Identifier
Description	Text	50	Name of Compartment
MannedOrUnmanned	Text	50	Manned/unmanned

*Used by Agents.

This information is not currently available through the interface.

May be used by Visualization in the future. Initial information is unknown currently, but the information is static.

5.17 Reaction Properties

This table is used to describe the chemical properties of certain reactions, used in conjunction with the FuelDescription table to accurately simulate anything involving fuel.

Name*	Type	Size	Notes
ReactionID	Number (Long)	4	
Description	Text	50	
ReactionType	Text	50	
O_2	Number (Single)	4	
CO_2	Number (Single)	4	
CO	Number (Single)	4	
H_2O	Number (Single)	4	
SO_2	Number (Single)	4	
SOOT	Number (Single)	4	
HEAT	Number (Single)	4	
Key	Number (Long)	4	Serial number

*Used by Simulation during initialization.

This information is not currently available through the interface. Currently only 2 entries for *Shadwell*.

5.18 Scuttles

Scuttles are circular openings within hatches.

Name*	Type	Size	Notes
ScuttleID	Number (Long)	4	Serial number
WallID	Number (Long)	4	Foreign key on Walls
Name	Text	50	Navy name for scuttle
CenterX	Number (Single)	4	
CenterY	Number (Single)	4	
CenterZ	Number (Single)	4	
Radius	Number (Single)	4	[ft]
HatchID	Number (Long)	4	Foreign key on Hatches

*Used by Agents.

Used by Simulation and Visualization during initialization. Scuttles can be visualized only. Currently contains static information for *Shadwell*.

5.19 Sides

A side (one face of a wall) is made of four vertices, listed in counterclockwise order with respect to their parent compartment. In particular, with a vertical side, vertices 2 and 3 will be the top vertices. Sides of type 0 are ceilings, type 1 are decks, and type 2 are vertical sides.

Name*	Type	Size	Notes
SideID	Number (Long)	4	Serial number
VertexID1	Number (Long)	4	Foreign key on Vertices
VertexID2	Number (Long)	4	Foreign key on Vertices
VertexID3	Number (Long)	4	Foreign key on Vertices
VertexID4	Number (Long)	4	Foreign key on Vertices
SideType	Number (Long)	4	Ceiling, deck, side
Level	Number (Long)	4	Level number
CompartmentID	Number (Long)	4	Foreign key on Compartments

*Used by Agents.

Used by Simulation and Visualization during initialization. This information is only available indirectly through the visualization. Currently contains static information for *Shadwell*.

5.20 Vertices

Lists all of the vertices in the ship.

Name*	Type	Size	Notes
VertexID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	

*Used by Agents.

Used by Simulation and Visualization during initialization. This information is only available indirectly through the visualization. This is static information for *Shadwell.*

5.21 WALLS

Each wall is composed of two sides. In some cases, the same compartment is on both sides of the wall; these walls are visualization artifacts. For horizontal walls, the first side is always the ceiling and the second the floor.

Name*	Type	Size	Notes
WallID	Number (Long)	4	Serial number
SideID1	Number (Long)	4	Foreign key on Sides
SideID2	Number (Long)	4	Foreign key on Sides
CompartmentID1	Number (Long)	4	Foreign key on Compartments
CompartmentID2	Number (Long)	4	Foreign key on Compartments
Thickness	Number (Single)	4	[units]
Material	Text	50	
WallType	Number (Long)	4	
OpeningType	Number (Long)	4	

*Used by Agents.

Used by Simulation and Visualization during initialization. This information is only available indirectly through the visualization. Currently contains static information for *Shadwell.*

6. Dynamic State Tables

These tables represent changing aspects of the ship's layout.

6.1 Agent Parameters

This table stores information necessary to understand some of the agents on the ship. These are generally just people who are not the DCA.

Name	Type	Size	Notes
Category	Text	50	Parameter category
Name	Test	50	Parameter name within category
IntValue	Number (Long)	4	Integer value
StringValue	Text	50	String value
Comment	Memo		Parameter description

This information is not currently available through the interface. There are some entries for *Shadwell*.

6.2 Changed Valve Status

This table tracks changes to valve status in the Fire Main system.

Name	Type	Size	Notes
ValveID	Number (Long)	4	Foreign key on Fire MainNodes
IsOpen	Yes/No	1	
ReadBy	Number (Long)	4	

This information can be found in the interface. Initially empty for *Shadwell*.

6.3 Compartment Status

Current physical status of each compartment.

Name*	Type	Size	Notes
CompartmentID	Number (Long)	4	Foreign key on Compartments
LowerZoneHeight	Number (Single)	4	[feet]
UpperZoneHeight	Number (Single)	4	[feet]
LowerZoneTemperature	Number (Single)	4	[Kelvin]
UpperZoneTemperature	Number (Single)	4	[Kelvin]
Pressure	Number (Single)	4	[pascals]
O2Concentration	Number (Single)	4	[mol/m^3]
FireStatus	Text	50	Ignited, engulfed, destroyed, extinguished, intact
FuelAmount	Number (Single)	4	[kg]
SootDensity	Number (Single)	4	[kg/m^3]
WaterDepth	Number (Single)	4	[meters]
FloodingStatus	Text	50	Intact, flooded
CO2Concentration	Number (Single)	4	[mol/m^3]
COConcentration	Number (Single)	4	[mol/m^3]
HFConcentration	Number (Single)	4	[mol/m^3]
HCIConcentration	Number (Single)	4	[mol/m^3]
HBrConcentration	Number (Single)	4	[mol/m^3]
CombustibleFuelAmount	Number (Single)	4	[kg]

*Used by Agents.

Used once per second by Simulation. Compartment status is available only indirectly through the visualization. Simulation will set the initial values for this table; the table can be empty.

6.4 Compartment Status Trace

Tracks "important" changes to status table (i.e. rows are never overwritten) for rewinds. For notes on the column values, see the Compartment Status table. Note that a '-2' value for Compartment ID marks a special 'parameters entry'.

Name*	Type	Size	Notes
TraceID	Number (Long)	4	Serial number
TimeTag	Number (Long)	4	
CompartmentID	Number (Long)	4	Foreign key on Compartments
LowerZoneHeight	Number (Single)	4	
LowerZoneTemperature	Number (Single)	4	
UpperZoneTemperature	Number (Single)	4	
Pressure	Number (Single)	4	
FireStatus	Text	50	
FloodingDepth	Number (Single)	4	[meters]
SmokeDensity	Number (Single)	4	

*Used by Sensor-To-Live.

Used once per second by Simulation. Used every 5 seconds by Visualization. This information can be seen by looking through the history in the interface. If an initial row is specified for this table using a false Compartment ID as –2, the user can specify the minimum differences between two continuous records for the same compartment that the simulator will observe. Otherwise the table can initially be empty.

6.5 Door Status

Lists whether each door on the ship is open or closed.

Name*	Type	Size	Notes
DoorID	Number (Long)	4	Foreign key on Doors
IsOpen	Yes/No	1	

*Used by Agents.

Used by Simulation during status changes. This information is not currently available through the interface. There should be specific initial states for each door.

6.6 Electrical System Alternate Connections

Lists alternate connections (one of three classes of connections) between electrical nodes.

Name*	Type	Size	Notes
ConnectionID	Number (Long)	4	Serial number
Node1	Number (Long)	4	Foreign key on ElectricalSystemNodes
Node2	Number (Long)	4	Foreign key on ElectricalSystemNodes
Intact	Yes/No	1	

*Used by Agents.

This information is not currently available through the interface. There is no information about *Shadwell.*

6.7 Electrical System Casualty Connections

Lists casualty connections (one of three classes of connections) between electrical nodes.

Name*	Type	Size	Notes
ConnectionID	Number (Long)	4	Serial number
Node1	Number (Long)	4	Foreign key on ElectricalSystemNodes
Node2	Number (Long)	4	Foreign key on ElectricalSystemNodes
Intact	Yes/No	1	

*Used by Agents.

This information is not currently available through the interface. Initially empty for *Shadwell.*.

6.8 Electrical System Generator Status

Dynamic generator status information.

Name*	Type	Size	Notes
Node	Number (Long)	4	Foreign key on ElectricalSystemNodes
Operational	Yes/No	1	
Running	Yes/No	1	

*Used by Agents.

This information is not currently available through the interface. There is no information about *Shadwell.*.

6.9 Electrical System Node Power

Dynamic power level information

Name8	Type	Size	Notes
Node	Number (Long)	4	Foreign key on ElectricalSystemNodes
Powerlevel	Number (Long)	4	% of normal power level

*Used by Agents.

This information is not currently available through the interface. There is no information about *Shadwell.*

6.10 Electrical System Normal Connections

Lists normal connections (one of three classes of connections) between electrical nodes.

Name*	Type	Size	Notes
ConnectionID	Number (Long)	4	Serial number
Node1	Number (Long)	4	Foreign key on ElectricalSystemNodes
Node2	Number (Long)	4	Foreign key on ElectricalSystemNodes
Intact	Yes/No	1	

*Used by Agents.

This information is not currently available through the interface. There is no information about *Shadwell.*

6.11 Explosions

Lists primary damage events.

Name*	Type	Size	Notes
ExplosionID	Number (Long)	4	Serial number
CompartmentID	Number (Long)	4	Foreign key on Compartments
Time	Number (Long)	4	
Severity	Number (Long)	4	Rating between 0 and 1 based on intensity
FuelResidue	Number (Long)	4	Kg
OxygenResidue	Number (Long)	4	Kg
PenetrationFactor	Number (Long)	4	Rating between 0 and 1 based on intensity
Fragmentation	Number (Long)	4	Rating between 0 and 1 based on intensity
Direction	Text	50	

*Used by primary damage simulator.

This information is not currently available through the interface. This table is initially empty.

6.12 Fire Boundaries

Current fire boundaries.

Name*	Type	Size	Notes
Set	Number (Long)	4	Set # this belongs to
SideID	Number (Long)	4	Foreign key on sides

*Used by Agents.

Used by Simulation during status changes. This information is not currently available through the interface. This table is initially empty.

6.13 Fire Main Deleted Nodes

Lists nodes (either original or dynamically created) deleted during simulation.

Name*	Type	Size	Notes
NodeID	Number (Long)	4	Foreign key on Fire MainNodes or Fire MainNewNodes

*Used by Agents.

There is a code for use of this table by Simulation, but it is not currently used. Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.14 Fire Main Deleted Pipes

Lists edges (either original or dynamically created) deleted during simulation.

Name	Type	Size	Notes
PipeID	Number (Long)	4	Foreign key on Fire MainPipes or Fire MainNewPipes

Used by Agents. There is code for use of this table by Simulation, but it is not currently used. Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.15 Fire Main Flow Rates

Current flow rates in fire main.

Name	Type	Size	Notes
EdgeID	Number (Long)	4	Foreign key on Fire Main (New) Pipe
FlowRate	Number (Single)	4	[gal/min]

Used by Simulation once per FM solving → per FM structure change. Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.16 Fire Main Gauge Status

Lists current gauge status.

Name	Type	Size	Notes
GaugeID	Number (Long)	4	Foreign key on Fire Main(New)Nodes
Status	Text	50	Online, offline.

Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.17 Fire Main New Nodes

Lists fire main edges created during simulation. See explanatory notes for the Fire MainNodes table. NodeID's must not overlap with those in Fire MainNodes.

Name*	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	Foreign key on Fire MainPipes
HandleTwo	Number (Long)	4	Foreign key on Fire MainPipes
HandleThree	Number (Long)	4	Foreign key on Fire MainPipes
NavyID	Text	50	
CompartmentID	Number (Long)	4	Foreign key on Compartments
InSea	Yes/No	1	

*Used by Agents.

There is code for use of this table by Simulation, but it is not currently used. Please keep. Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.18 Fire Main New Pipes

Lists fire main edges created during simulation. See explanatory notes for the Fire MainPipes table. PipeID's must not overlap with those in Fire MainPipes.

Name*	Type	Size	Notes
PipeID	Number (Long)	4	Serial number
HeadNodeID	Number (Long)	4	Foreign key on Fire MainNodes
TailNodeID	Number (Long)	4	Foreign key on Fire MainNodes
CompartmentID	Number (Long)	4	Foreign key on Compartments
Diameter	Number (Single)	4	[ft]

*Used by Agents.

There is code for use of this table by Simulation, but it is not currently used. Visualization may use this table in the future. This information is not currently available through the interface. This table is initially empty.

6.19 Fire Main Plugs

Lists status of plugs in fire main system.

Name*	Type	Size	Notes
PlugID	Number (Long)	4	Foreign key on Fire Main(New)Nodes
IsOpen	Yes/No	1	

*Used by Agents.

Used by Simulation during initialization. Visualization may use this table in the future. This information is not currently available through the interface. This table has a specific number of plugs for each ship, but the initial state is to be closed for each plug.

6.20 Fire Main Pressures

Lists pressures of each fire main node.

Name*	Type	Size	Notes
NodeID	Number (Long)	4	Foreign key on Fire Main(New)Nodes
Handle	Number (Long)	4	Foreign key on Fire Main(New)Pipes
Pressure	Number (Single)	4	[psi]

*Used by Agents.

Used by Simulation during status changes (same as Fire MainFlowRates).

Visualization may use this table in the future (but would prefer a trace table). This information is not currently available through the interface. This table is initially empty.

6.21 Fire Main Pumps

Lists status of fire main pumps.

Name*	Type	Size	Notes
PumpID	Number (Long)	4	Foreign key on Fire Main(New)Pipes
MaximumFlowRate	Number (Single)	4	[gal/min]
MaximumHeadGain	Number (Single)	4	[units]
TailNodeID	Number (Long)	4	
HeadNodeID	Number (Long)	4	
Status	Text	50	On, off, standby, overheating, damaged, destroyed.
PowerLevel	Number (Single)	4	[percentage]
CompartmentID	Number (Long)	4	Foreign key on Compartments
IsOn	Yes/No	1	
Name	Text	50	Pump number

*Used by Agents and DCTFire Main (HCI).

Used by Simulation during status changes. Visualization may use this table in the future. Used by DCTMessageBlank (HCI) during initialization. This information is not currently available through the interface. The initial information is specific to each ship.

6.22 Fire Main Pumps Log

This table tracks changes to pump status.

Name	Type	Size	Notes
PumpID	Number (Long)	4	Foreign key on Fire Main(New)Pipes
MaximumFlowRate	Number (Single)	4	[gal/s]
MaximumHeadGain	Number (Single)	4	[units]
TailNodeID	Number (Long)	4	
HeadNodeID	Number (Long)	4	
Status	Text	50	On, off, standby, overheating, damaged, destroyed.
PowerLevel	Number (Single)	4	[percentage]
CompartmentID	Number (Long)	4	Foreign key on Compartments
IsOn	Yes/No	1	
Name	Text	50	Pump number

This information is not currently available through the interface. This table is initially empty.

6.23 Fire Main Ruptures

Lists fire main ruptures formed during simulation

Name*	Type	Size	Notes
RuptureID	Number (Long)	4	Serial number
PipeID	Number (Long)	4	Foreign key on Fire Main(New)Pipes
Position	Number (Single)	4	Offset from pipe tail [ft]
CrackWidth	Number (Single)	4	[ft]
CrackLength	Number (Single)	4	[ft]
LeakRate	Number (Single)	4	[gal/min]
Patched	Yes/No	1	Has it been patched or not

*Used by Agents.

Used by Simulation during status changes. This information is not currently available through the interface. This table is initially empty.

6.24 Fire Main Valves

Lists current status of each valve on the ship.

Name*	Type	Size	Notes
ValveID	Number (Long)	4	Node identifier
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	Navy status code

*Used by Agents and DCTFire Main (HCI).

Used by Simulation during status changes. Visualization may use this table in the future. Used by DCTMessageBlank (HCI) during initialization. This information is not currently available through the interface. The initial state is specific to the ships fire main status.

6.25 Fire Main Valves Log

This table tracks changes to valve status

Name	Type	Size	Notes
ValveID	Number (Long)	4	Node identifier
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	

This information is not currently available through the interface. This table should be initially empty.

6.26 Hatch Status

Lists whether each hatch on the ship is opened or closed.

Name*	Type	Size	Notes
HatchID	Number (Long)	4	Foreign key on Hatches
IsOpen	Yes/No	1	

*Used by Agents.

Used by Simulation during status changes. This information is not currently available through the interface. There should be specific initial states for each hatch.

6.27 HCI Buffering Values

Name*	Type	Size	Notes
Identifier	Number (Long)	4	Serial number
HCI Entries	Number (Long)	4	
Slab 1	Number (Double)	8	
Slab 2	Number (Double)	8	
Slab 3	Number (Double)	8	
Slab 4	Number (Double)	8	
Slab 5	Number (Double)	8	
Slab 6	Number (Double)	8	
Slab 7	Number (Double)	8	

*Used by Simulation during status changes.

This information is not currently available through the interface. Table is initially empty.

6.28 Scuttle Status

Lists whether each scuttle on the ship is opened or closed.

Name*	Type	Size	Notes
ScuttleID	Number (Long)	4	Foreign key on Scuttles
IsOpen	Yes/No	1	

*Used by Agents.

Used by Simulation during status changes (same as HatchStatus). This information is not currently available through the interface. There should be specific initial states for each scuttle.

6.29 Smoke Boundaries

Current smoke boundaries in effect.

Name	Type	Size	Notes
VentID	Number (Long)	4	Foreign key on the type of vent
VentType	Text	50	Door, hatch, scuttle, wallrupture

This information is not currently available through the interface. Not currently in use.

6.30 Stability

Two pieces of data for the stability simulator. NM height measures the difference between the center of buoyancy and the center of gravity.

Name*	Type	Size	Notes
FloodingTotal	Number (Double)	8	[lbs] total weight of water aboard ship
NM	Number (Double)	8	[ft] relative negative metacentric height

*Used by stability agent.

This information is not currently available through the interface.

6.31 Wall Material Information

Name	Type	Size	Notes
Identifier	Number (Long)	4	Serial number
Material Name	Text	50	From CFAST
Slab Conduction	Number (Long)	4	
Slab Density	Number (Long)	4	
Slab Thickness	Number (Long)	4	
Slab Number	Number (Long)	4	
Slab SH	Number (Long)	4	
Emissitivity	Number (Double)	8	
HCI Buffering	Number (Long)	4	
Material Description	Text	75	

Not used by Simulation but may cause problems if removed. This information is not currently available through the interface. This table is initially empty.

6.32 Wall Material Slab Data

Name	Type	Size	Notes
Identifier	Number (Long)	4	Serial number
Slab Number	Number (Long)	4	
Slab 1	Number (Double)	8	
Slab 2	Number (Double)	8	
Slab 3	Number (Double)	8	
Slab 4	Number (Double)	8	
Slab 5	Number (Double)	8	
Slab 6	Number (Double)	8	

Not used by Simulation but may cause problems if removed .This information is not currently available through the interface. This table is initially empty.

6.33 Wall Ruptures

Lists wall ruptures formed during simulation.

Name*	Type	Size	Notes
RuptureID	Number (Long)	4	Serial number
WallID	Number (Long)	4	Foreign key on Walls
Height	Number (Single)	4	[m] from deck to center of rupture
RuptureArea	Number (Single)	4	[ft^2]
RuptureClass	Text	50	

*Used by Agents.

Used by Simulation during status changes (once per rupture adding). This information is not currently available through the interface. This table is initially empty.

7. SHADWELL Table.

7.1 AFFF Hose Reel Nodes - Static

The AFFF system is modeled as an undirected graph; this table describes the nodes of the AFFF system. A node is anything that can affect flow within the AFFF system: valves, junction, narrowings, widenings, gauges, and pumps, for instance. The handle fields are used to describe certain kinds of connection information, as any given node may only be the endpoint of at most three edges. So an end node will only connect to one edge; this edgeID is stored in HandleOne. A node connecting two edges (like an elbow joint) will have values for HandleOne and HandleTwo. For a node incident to three edges (like a T-junction), all three handles will contain the ID's of the incident edges. Any unused handles will contain –1 as their value.

Name	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	Foreign key on AFFFHosereelPipe
HandleTwo	Number (Long)	4	Foreign key on AFFFHosereelPipe
HandleThree	Number (Long)	4	Foreign key on AFFFHosereelPipe
InAtmsphere	Yes/No	1	
CompartmentID	Number (Long)	4	Foreign key on Compartments
VertexType	Text	50	Describes the nature of node
Name	Text	50	Navy ID (valves only)

This information is not currently available through the interface.

7.2 AFFF Hose Reel Pipe - Static

This table lists the edges of the AFFF graph; by default flow is from head to tail.

Name	Type	Size	Notes
DuctID	Number (Long)	4	Serial number
HeadNodeID	Number (Single)	4	Foreign key on AFFFHosereelNodes
TailNodeID	Number (Single)	4	Foreign key on AFFFHosereelNodes
CompartmentID	Number (Integer)	2	Foreign key on Compartments
Diameter	Number (Single)	4	[ft]

This information is not currently available through the interface.

7.3 AFFF Hose Reels - Dynamic

This table lists the status of each of the AFFFHoseReels.

Name	Type	Size	Notes
HosereelID	Number (Long)	4	Serial number
HeadNodeID	Number (Long)	4	Foreign key on AFFFHosereelNodes
Status	Text	50	
CompartmentID	Number (Long)	4	Foreign key on Compartments
IsInUse	Yes/No	1	
Name	Number (Long)	4	Navy name for pump

This information is not currently available through the interface.

7.4 AFFF Hose Reel Valves – Dynamic

This table lists the status of each AFFF Hosereel Valve.

Name	Type	Size	Notes
ValveID	Number (Long)	4	Foreign key on AFFFHosereelNodes
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	

This information is not currently available through the interface.

7.5 Compartment Sensor Key - Static

This table lists the abbreviations used for different types of compartment sensors.

Name	Type	Size	Notes
Abbreviation	Text	50	
Sensor/Instrument	Text	50	Name of sensor/instrument

This information is not currently available through the interface. Information is static for *Shadwell.*

7.6 Compartment Sensors - Static

This table lists for each sensor its location, its channel number, and the compartment it is in. This table is vital because when data is sent from the ship it is encoded by Channel# and we need to be able to map those channels to compartments. If a sensor is not in this table it will not make it through to the system because we would have no way of knowing by Channel# where the sensor is or just as important what kind of sensor it is.

Name	Type	Size	Notes
SensorID	Number (Long)	4	Serial number
SensorType	Text	50	
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
Channel#	Text	50	
Location	Text	50	Canonical name
Compartment	Number (Long)	4	Foreign key on compartments

This information is not currently available through the interface. Information is static for *Shadwell.*

7.7 Compartment Status Belief – Dynamic

This table is used to represent, per compartment, what the current believed state of that compartment is by the intelligent reasoning component. There are three categories--Fire, Smoke, and Flood--that need to be identified to assess the current situation in any compartment.

Name	Type	Size	Notes
CompartmentID	Number (Long)	4	Foreign key on compartments
Fire	Number (Single)	4	
Smoke	Number (Single)	4	
Flood	Number (Single)	4	

This information is not currently available through the interface.

7.8 COTS - Static

This table lists the Commercial-Off-The-Shelf items that are used for various sensoring purposes.

Name	Type	Size	Notes
SensorID	Number (Long)	4	Serial number
SensorType	Text	50	Abbreviation of type of sensor
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
Location	Text	50	Canonical name
CompartmentID	Number (Long)	4	Foreign key on compartments

This information is not currently available through the interface.

7.9 COTSKey - Static

This table lists the abbreviations used for different types of COTS.

Name	Type	Size	Notes
Abbreviation	Text	50	
Sensor/Instrument	Text	50	Name of sensor/instrument

This information is not currently available through the interface.

7.10 Fire Main Sensor Key - Static

This table lists the abbreviation used for different types of fire main sensors.

Name	Type	Size	Notes
Abbreviation	Text	50	
Sensor/Instrument	Text	50	Name of sensor/instrument

This information is not currently available through the interface. Information is static for *Shadwell*.

7.11 Fire Main Sensors - Static

This table lists the fire main sensors and their location.

Name	Type	Size	Notes
SensorID	Number (Long)	4	Serial number
SensorType	Text	50	Abbreviation of type of sensor
X	Number (Long)	4	
Y	Number (Long)	4	
Z	Number (Long)	4	
Channel#	Text	50	
Location	Number (Long)	4	Canonical location on ship
CompartmentID	Number (Long)	4	Foreign key on compartments
PositionID	Number (Long)	4	Possible foreign key on Fire MainNodes, Fire MainPipes, and Fire MainPumps.

This information is not currently available through the interface. Information is static for *Shadwell.*

7.12 Fuel Multipliers - Static

Name	Type	Size	Notes
Compartment ID	Number (Long)	4	Foreign key on compartments
Fuel Multiplier	Number (Single)	4	

This information is not currently available through the interface. Currently unused.

7.13 HFP Nodes – Static (This System Does Not Exist on *Shadwell)*

The HFP (heptaflouropropane) system is modeled as an undirected graph; this table describes the nodes of the HFP system. A node is anything that can affect flow within the HFP system: valves, junction, narrowings, widenings, gauges, and pumps, for instance. The handle fields are used to describe certain kinds of connection info, as any given node may only be the endpoint of at most three edges. So an end node will only connect to one edge; this edgeID is stored in HandleOne. A node connecting two edges (like an elbow joint) will have values for HandleOne and HandleTwo. For a node incident to three edges (like a T-junction), all three handles will contain the ID's of the incident edges. Any unused handles will contain –1 as their value.

Name	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	Foreign key on HFPPipes
HandleTwo	Number (Long)	4	Foreign key on HFPPipes
HandleThree	Number (Long)	4	Foreign key on HFPPipes
InSea	Yes/No	1	
CompartmentID	Number (Long)	4	Foreign key on Compartments
VertexType	Text	50	Describes the nature of node
Name	Text	50	Navy ID (valves only)

This information is not currently available through the interface.

7.14 HFP Pipes - Static

This table lists the edges of the HFP graph; by default flow is from head to tail.

Name	Type	Size	Notes
PipeID	Number (Long)	4	Serial number
HeadNodeID	Number (Long)	4	Foreign key on HFPNodes
TailNodeID	Number (Long)	4	Foreign key on HFPNodes
CompartmentID	Number (Long)	4	Foreign key on Compartments
Diameter	Number (Single)	4	[ft]

This information is not currently available through the interface.

7.15 HFP Valves - Dynamic

This table lists the status of each HFP Valve.

Name	Type	Size	Notes
ValveID	Number (Long)	4	Foreign key on HFPNodes
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	

This information is not currently available through the interface.

7.16 LiveData – Dynamic

This table is used to hold the changes to compartments as they come in from the sensors. This table is vital to each component that reasons on the state of a compartment. This table is similar to the CompartmentStatus table in that it holds information about the current state of a compartment, but its usefulness comes from the calculation of change from the previous information of a given compartment. With the delta data, more advanced reasoning decisions can be made.

Name*	Type	Size	Notes
LiveDataId	Number (Long)	4	Serial number
TimeStamp	Number (Long)	4	Time the information was received
CompartmentID	Number (Long)	4	Foreign key on Compartments
LowerZoneTemperature	Number (Single)	4	
DeltaLowerZoneTemperature	Number (Single)	4	
UpperZoneTemperature	Number (Single)	4	
DeltaUpperZoneTemperature	Number (Single)	4	
O2	Number (Single)	4	
DeltaO2	Number (Single)	4	
CO	Number (Single)	4	
DeltaCO	Number (Single)	4	
CO2	Number (Single)	4	
DeltaCO2	Number (Single)	4	
Obscuration	Number (Single)	4	
DeltaObscuration	Number (Single)	4	
NuisanceFireCF	Number (Double)	8	
CriticalFireCF	Number (Double)	8	
FloodStatus	Number (Double)	8	
SmokeStatus	Number (Double)	8	

*Used by Sensor-To-Live (write-only).

Used by Bayesian Classifier (read/write). This information comes from the Sensor Input table, and presents updates to the current status of individual compartments as they happen. This table is to be initially empty.

7.17 Sensor Input - Dynamic

This table is used to track the different values the sensors give over the course of a simulation.

Name*	Type	Size	Notes
Serial	Number (Long)	4	Serial number
TimeStamp	Number (Long)	4	Time the sensor is giving information
CompartmentID	Number (Long)	4	Foreign key on Compartments
SensorType	Text	50	
Value	Number (Single)	4	Information from sensor

*Used by Sensor-To-Live (read/write).

This information gets converted and placed into the LiveData table and the CompartmentStatusTrace table from where it is represented to the user in the visualization. This table is to be initially empty.

7.18 Ventilation Dampers

This table contains the status of any of the Ventilation dampers.

Name	Type	Size	Notes
DamperID	Number (Long)	4	Foreign key on VentilationNodes
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	

This information is not currently available through the interface.

7.19 Ventilation Duct

This table contains all the information about the ventilation system. By default flow is from head to tail.

Name	Type	Size	Notes
DuctID	Number (Long)	4	Serial number
HeadNodeID	Number (Single)	4	Foreign key on VentilationNodes
TailNodeID	Number (Single)	4	Foreign key on VentilationNodes
CompartmentID	Number (Integer)	2	Foreign key on Compartments
Diameter	Number (Single)	4	
Height	Number (Single)	4	
Width	Number (Single)	4	

This information is not currently available through the interface.

7.20 Ventilation Fans

This table holds the information for the ventilation fans on the ship.

Name	Type	Size	Notes
FanID	Number (Long)	4	Serial number
MaximumFlowRate	Number (Single)	4	
MaximumHeadGain	Number (Single)	4	
TailNodeID	Number (Long)	4	Foreign key on VentilationNodes
HeadNodeID	Number (Long)	4	Foreign key on VentilationNodes
Status	Text	50	
PowerLevel	Number (Single)	4	Percentage of power
CompartmentID	Number (Long)	4	Foreign key on Compartments
IsOn	Yes/No	1	
Name	Text	50	

This information is not currently available through the interface.

7.21 Ventilation Nodes

The Ventilation system is modeled as an undirected graph; this table describes the nodes of the Ventilation system. A node is anything that can affect flow within the Ventilation system: valves, junction, narrowings, widenings, gauges, and pumps, for instance. The handle fields are used to describe certain kinds of connection information, as any given node may only be the endpoint of at most three edges. So an end node will only connect to one

edge; this edgeID is stored in HandleOne. A node connecting two edges (like an elbow joint) will have values for HandleOne and HandleTwo. For a node incident to three edges (like a T-junction), all three handles will contain the ID's of the incident edges. Any unused handles will contain –1 as their value.

Name	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	
HandleTwo	Number (Long)	4	
HandleThree	Number (Long)	4	
InAtmsphere	Yes/No	1	
CmprtmntID	Number (Long)	4	Foreign key on Compartments
VertexType	Text	50	
Name	Text	50	Canonical ship name

This information is not currently available through the interface.

7.22 Watermist Nodes

The Watermist system is modeled as an undirected graph; this table describes the nodes of the Watermist system. A node is anything that can affect flow within the Watermist system: valves, junction, narrowings, widenings, gauges, and pumps, for instance. The handle fields are used to describe certain kinds of connection info, as any given node may only be the endpoint of at most three edges. So an end node will only connect to one edge; this edgeID is stored in HandleOne. A node connecting two edges (like an elbow joint) will have values for HandleOne and HandleTwo. For a node incident to three edges (like a T-junction), all three handles will contain the ID's of the incident edges. Any unused handles will contain –1 as their value.

Name	Type	Size	Notes
NodeID	Number (Long)	4	Serial number
X	Number (Single)	4	
Y	Number (Single)	4	
Z	Number (Single)	4	
HandleOne	Number (Long)	4	
HandleTwo	Number (Long)	4	
HandleThree	Number (Long)	4	
InSea	Yes/No	1	
CompartmentID	Number (Long)	4	Foreign key on Compartments
VertexType	Text	50	
Name	Text	50	Canonical ship name

This information is not currently available through the interface.

7.23 Watermist Pipes

This table contains all the information about the watermist pipes. By default flow is from head to tail.

Name	Type	Size	Notes
PipeID	Number (Long)	4	Serial number
HeadNodeID	Number (Integer)	2	Foreign key on WatermistNodes
TailNodeID	Number (Integer)	2	Foreign key on WatermistNodes
CompartmentID	Number (Integer)	2	Foreign key on Compartments
Diameter	Number (Single)	4	Feet

This information is not currently available through the interface.

7.24 Watermist Pumps

This table holds the information for the watermist pumps on the ship.

Name	Type	Size	Notes
PumpID	Number (Long)	4	Foreign key on WatermistPipes
MaximumFlowRate	Number (Single)	4	
MaximumHeadGain	Number (Single)	4	
TailNodeID	Number (Long)	4	Foreign key on WatermistNodes
HeadNodeID	Number (Long)	4	Foreign key on WatermistNodes
Status	Text	50	
PowerLevel	Number (Single)	4	Percentage of power
CompartmentID	Number (Long)	4	Foreign key on Compartments
IsOn	Yes/No	1	
Name	Text	50	

This information is not currently available through the interface.

7.25 Watermist Valves

This table contains the status of any of the Watermist valves.

Name	Type	Size	Notes
ValveID	Number (Long)	4	Foreign key on WatermistNodes
IsOpen	Yes/No	1	
IsRemoteControllable	Yes/No	1	
Status	Text	50	

This information is not currently available through the interface.

8. Communication

These tables are ship-independent; they hold inter-module communications information.

8.1 ECL Grammar

A machine-readable grammar for ECL (Event Communication Language) messages occurs in this table.

Name	Type	Size	Notes
Number	Number (Long)	4	Message number
Message	Memo	-	Description
Parameters	Memo	-	Argument
Example	Memo	-	Example text
Grammar	Memo	-	Composition
ParameterExample	Memo	-	Parameter desc.

Used by programmers. This information is not currently available through the interface. This table is static.

8.2 ECL Messages

All communications between modules occurs in this table.

Name*	Type	Size	Notes
Serial	Number (Long)	4	Serial number
ECLNum	Number (Long)	4	Message number
Timestamp	Number (Long)	4	Timestamp
To	Text	50	Addressee
From	Text	50	Sender
Problem	Text	50	Parameter 1
System	Text	50	Parameter 2
Alarm	Text	50	Parameter 3
Status	Text	50	Parameter 4
Adjective	Text	50	Parameter 5
Compartment	Text	50	Parameter 6
String1	Text	50	Parameter 7
String2	Text	50	Parameter 8
Num1	Number (Long)	4	Parameter 9
Num2	Number (Long)	4	Parameter 10
Saft	Number (Long)	4	Parameter 11
Paft	Number (Long)	4	Parameter 12
Pfor	Number (Long)	4	Parameter 13
Sfor	Number (Long)	4	Parameter 14
Above	Number (Long)	4	Parameter 15
Below	Number (Long)	4	Parameter 16

*Used by Agents, Minerva, DCTFire Main (HCI), and DCTInterface (HCI)

Used by Bayesian Classifier (write-only). Used by DCTMessageBlank during initialization. Used by

DCXAction during status changes (write on occasion). Used once per second by Simulation. Used every 5 seconds by Visualization. This information can be accessed through the interface. The information gets into this table from the PendingECLMessages table. This table is initially empty.

8.3 Legal ECL Parameters

This table lists appropriate strings for ECL messages.

Name*	Type	Size	Notes
Parameter	Text	50	ECLMessages field
Value	Text	50	Acceptable string
Context	Text	50	When applicable

*Used by DCTMessageBlank during initialization.

Used by programmers. This information is not currently available through the interface. This table has static information initially.

8.4 Pending ECL Messages

Stores messages not yet ready to go into the ECLMessages table. Messages waiting to be read.

Name*	Type	Size	Notes
Serial	Number (Long)	4	Serial number
ECLNum	Number (Long)	4	Message number
Timestamp	Number (Long)	4	Timestamp
To	Text	50	Addressee
From	Text	50	Sender
Problem	Text	50	Parameter 1
System	Text	50	Parameter 2
Alarm	Text	50	Parameter 3
Status	Text	50	Parameter 4
Adjective	Text	50	Parameter 5
Compartment	Text	50	Parameter 6
String1	Text	50	Parameter 7
String2	Text	50	Parameter 8
Num1	Number (Long)	4	Parameter 9
Num2	Number (Long)	4	Parameter 10
Saft	Number (Long)	4	Parameter 11
Paft	Number (Long)	4	Parameter 12
Pfor	Number (Long)	4	Parameter 13
Sfor	Number (Long)	4	Parameter 14
Above	Number (Long)	4	Parameter 15
Below	Number (Long)	4	Parameter 16
Activation-Status	Text	50	Pending, Activated, Overridden

*Used by Agents and Minerva.

Used by DCXAction (HCI) 1-2 times per second.

This information gets parsed and presented to the user when it gets placed into this table. The user then confirms that he has received it and then it goes to the ECLMessages table. This table is initially empty.

9. Event Communication Language

All intermodule communication in the Illinois DCTRAIN system occurs through the ECL. Each parameter is often used for a default purpose, as listed in the table .

Parameter	Default Usage
Above	Vertical boundary
Adjective	Location modifier
Alarm	Alarm description
Below	Vertical boundary
Compartment	KBS compartment ID
Num1	Numeric data
Num2	Numeric data
Paft	Horizontal boundary
Pfor	Horizontal boundary
Problem	Problem description
Saft	Horizontal boundary
Sfor	Horizontal boundary
Status	Status description
String1	String data
String2	String data
System	Ship system

9.1 ECL Messages

1000: Messages from the DCA

1100: Orders to the agents

1101: Investigate compartment
([from], "ordered", [to], "to investigate compartment", [compartment], "for suspected status", [status])
1102: Abort compartment investigation
([from], "ordered", [to], "to stop investigating compartment", [compartment])

1105: Access compartment
([from], "ordered", [to], "to access compartment", [compartment])

1106: Evacuate compartment

([from], "ordered", [to], "to evacuate compartment", [compartment])

1111: Fight problem (fire, flood)
([from], "ordered", [to], "to fight", [problem], "in compartment", [compartment])

1112: Abort problem-fighting efforts
([from], "ordered", [to], "to stop fighting", [problem], "in compartment", [compartment])

1115: Patch pipe
([from], "ordered", [to], "to patch", [system], "pipe in compartment", [compartment])

1116: Patch wall ruptures
([from], "ordered", [to], "to patch walls in compartment", [compartment])

1121: Set boundaries
([from], "ordered", [to], "to set", [problem], "boundaries", [sfor], [pfor], [paft], [saft], "between decks", [above], "and", [below])

1122: Cancel boundaries
([from], "ordered", [to], "to abandon", [problem], "boundaries", [sfor], [pfor], [paft], [saft], "between decks", [above], [below])

1125: Isolate compartment
([from], "ordered", [to], "to isolate compartment", [compartment], [status])
Status is electrical/mechanical/both

1131: Open valve
([from], "ordered", [to], "to open", [system], "valve", [string1])

1132: Close valve
([from], "ordered", [to], "to shut", [system], "valve", [string1])

1135: Start pump
([from], "ordered", [to], "to start", [system], "pump", [num1])

1136: Stop pump
([from], "ordered", [to], "to stop", [system], "pump", [num1])

1141: Flood compartment
([from], "ordered", [to], "to flood compartment", [compartment])

1142: Activate system in compartment
([from], "ordered", [to], "to activate", [system], "in compartment", [compartment])

1143: Activate system in compartment for specified number of minutes
([from], "ordered", [to], "to activate", [system], "in compartment", [compartment], "for", [num1],"minutes")

1145: Secure (deactivate) system
([from], "ordered", [to], "to secure", [system], "in compartment", [compartment])

1151: Overhaul compartment
([from], "ordered", [to], "to overhaul compartment", [compartment])

1152: Dewater compartment
([from], "ordered", [to], "to dewater compartment", [compartment])

1153: Desmoke compartment
([from], "ordered", [to], "to desmoke compartment", [compartment], "using", [string1])

1161: Route casualties
([from], "ordered", [to], "to route casualties from compartment", [compartment], "to compartment", [string1], "via compartment", [string2])

1162: Route casualty power
([from], "ordered", [to], "to route casualty power from", [string1], "to", [string2])

1163: Energize casualty power
([from], "ordered", [to], "to energize casualty power")

1191 Cancel reflash watch
([from], "ordered", [to], "to cancel reflash watch in compartment", [compartment])

1192 Set reflash watch
([from], "ordered", [to], "to set reflash watch in compartment", [compartment])

1500: Requests

1501: Request MR/Z report
([to], [from], "requests status of manned and ready and zebra set")

1505: Request report of personnel availability
([to], [from], "requests personnel availability report")

1511: Request status of problem-fighting efforts
([to], [from], "requests status of", [problem], "in compartment", [compartment])

1535: Request permission to start pump
([to], [from], "requests", "permission", "to", "start", [system], "pump", [num1])

1541: Request permission to flood compartment
([to], [from], "requests", "permission", "to", "flood", "compartment", [compartment])

1542: Request report of effectiveness of some system or automatic fire suppression agent
([to], [from], "requests status of", [system], "in compartment", [compartment])

1553: Request permission to desmoke compartment
([from], "requested permission to desmoke compartment", [compartment], "using", [string1], "from", [to])

1562: Ask permission to route casualty power
([from], "requested permission from", [to], "to route casualty power from", [num1], "to", [num2])

1563: Ask permission to energize casualty power
([from], "requested permission from", [to], "to energize casualty power")

1600: Responses to requests

1601: MR/Z progress report
([to], [from], "reports", [status])

1671: Recommend MOPP level
([from], "recommended", [string1], "MOPP level", [num1])
To recommend securing from MOPP, set [num1] = 0.

1699: Abandon ship
([from], "recommends abandoning the ship")

1900: Order Cancellations

1901: Cancel "investigate compartment"
([from], "ordered", [to], "to investigate compartment", [compartment])

1905: Cancel "Access compartment"
([from], "ordered", [to], "to access compartment", [compartment])

1906: Cancel "Evacuate compartment"
([from], "ordered", [to], "to evacuate compartment", [compartment])

1911: Cancel "Fight problem" (fire, flood)
([from], "ordered", [to], "to fight", [problem], "in compartment", [compartment])

1915: Cancel "Patch pipe"
([from], "ordered", [to], "to patch", [system], "pipe in compartment", [compartment])

1916: Cancel "Patch wall ruptures"
([from], "ordered", [to], "to patch walls in compartment", [compartment])

1921: Cancel "Set boundaries"
([from], "ordered", [to], "to set", [problem], "boundaries", [sfor], [pfor], [paft], [saft], "between decks", [above], "and", [below])

1925: Cancel "Isolate compartment"
([from], "ordered", [to], "to isolate compartment", [compartment], [status])
Status is electrical, mechanical, or both.

1931: Cancel "Open valve"
([from], "ordered", [to], "to open", [system], "valve", [string1])

1932: Cancel "Close valve"
([from], "ordered", [to], "to shut", [system], "valve", [string1])

1935: Cancel "Start pump"
([from], "ordered", [to], "to start", [system], "pump", [num1])

1936: Cancel "Stop pump"
([from], "ordered", [to], "to stop", [system], "pump", [num1])

1941: Cancel "Flood compartment"
([from], "ordered", [to], "to flood compartment", [compartment])

1942: Cancel "Activate system in compartment"
([from], "ordered", [to], "to activate", [system], "in compartment", [compartment])

1943: Cancel "Activate system in compartment for specified number of minutes"
([from], "ordered", [to], "to activate", [system], "in compartment", [compartment], "for", [num1], "minutes")

1945: Cancel "Secure (deactivate) system"
([from], "ordered", [to], "to secure", [system], "in compartment", [compartment])

1951: Cancel "Overhaul compartment"
([from], "ordered", [to], "to overhaul compartment", [compartment])

1952: Cancel "Dewater compartment"
([from], "ordered", [to], "to dewater compartment", [compartment])

1953: Cancel "Desmoke compartment"
([from], "ordered", [to], "to desmoke compartment", [compartment], "using", [string1])

1961: Cancel "Route casualties"
([from], "ordered", [to], "to route casualties from compartment", [compartment], "to compartment", [string1], "via compartment", [string2])

1962: Cancel "Route casualty power"
([from], "ordered", [to], "to route casualty power from", [string1], "to", [string2])

1963: Cancel "Energize casualty power"
([from], "ordered", [to], "to energize casualty power")

2000: Messages from the agents

2100: Acknowledgements of orders

2101: Investigate compartment aye!
([from], "investigate", "compartment", [compartment], "aye")

2102: Abort compartment investigation aye!

([from], "stop investigating compartment", [compartment], "aye")

2105: Access compartment aye!
([from], "access compartment", [compartment], "aye")

2106: Evacuate compartment aye!
([from], "evacuate compartment", [compartment], "aye")

2111: Fight problem aye!
([from], "fight", [problem], "in compartment", [compartment], "aye")

2112: Abort problem-fighting efforts aye!
([from], "stop fighting", [problem], "in compartment", [compartment], "aye")

2115: Patch pipe aye!
([from], "patch", [system], "pipe in compartment", [compartment], "aye")

2116: Patch wall aye!
([from], "patch walls in compartment", [compartment], "aye")

2121: Set boundaries aye!
([from], "set", [problem], "boundaries", "aye")

2122: Cancel boundaries aye!
([from], "abandon", [problem], "boundaries aye")

2125: Isolate compartment aye!
([from], "isolate", "compartment", [compartment], "aye")

2131: Open valve aye!
([from], "open", [system], "valve", [string1], "aye")

2132: Close valve aye!
([from], "shut", [system], "valve", [string1], "aye")

2135: Start pump aye!
([from], "start", [system], "pump", [num1], "aye")

2136: Stop pump aye!
([from], "stop", [system], "pump", [num1], "aye")

2141: Flood compartment aye!
([from], "flood", "compartment", [compartment], "aye")

2142: Activate system aye!
([from], "activate", [system], "in compartment", [compartment], "aye")

2145: Secure system aye!
([from], "secure", [system], "in compartment", [compartment], "aye")

2151: Overhaul compartment aye!
([from], "overhaul compartment", [compartment], "aye")

2152: Dewater compartment aye!
([from], "dewater compartment", [compartment], "aye")

2153: Desmoke compartment aye!
([from], "desmoke compartment", [compartment], "using", [string1], "aye")

2161: Route casualties aye!
([from], "route casualties from", [compartment], "to" [string1], "via", [string2], "aye")

2162: Route casualty power aye!
([from], "route casualty power from", [compartment], "to" [num1], "via", [num2], "aye")

2163: Energize casualty power aye!
([from], "energize casualty power aye")

2200: Reports that orders are in progress

2201: Investigators away
([to], [from], "reports investigators away to compartment", [compartment])

2211: fighting in progress
([to], [from], "reports", [problem], "fighting in progress in compartment", [compartment])

2212: Firefighters away
([to], [from], "reports firefighters away to compartment", [compartment])

2221: Boundaries being set
([to], [from], "reports", [problem], "boundaries in progress")

2241: Flooding compartment
([to], [from], "is flooding compartment", [compartment])

2242: Activating system in compartment
([to], [from], "is activating", [system], "in compartment", [compartment])

2252: Dewatering in progress
([to], [from], "reports dewatering in progress in compartment", [compartment])

2253: Desmoking in progress
([to], [from], "reports desmoking in progress in compartment", [compartment])

2300: Positive outcome reports for orders

2301: Compartment has been investigated
([to], [from], "reports compartment", [compartment], "has been investigated and problem found to be", [status], "with", [adjective])

2305: Compartment has been accessed
([to], [from], "reports compartment", [compartment], "has been accessed")

2306: Compartment has been evacuated
([to], [from], "reports compartment", [compartment], "has been evacuated")

2311: Problem under control
([to], [from], "reports", [problem], "under control in compartment", [compartment])

2315: Pipe patched
([to], [from], "reports", [system], "pipe in compartment", [compartment], "has been patched")

2316: Wall patched
([to], [from], "reports", [system], "walls in compartment", [compartment], "have been patched")

2321: Boundaries set
([to], [from], "reports", [problem], "boundaries set")

2325: Compartment isolated
([to], [from], "reports", [status], "isolation of compartment", [compartment], "is complete")

2331: Valve opened
([to], [from], "reports", [system], "valve", [string1], "was opened")

2332: Valve closed
([to], [from], "reports", [system], "valve", [string1], "was shut")

2335: Pump started
([to], [from], "reports", [system], "pump", [num1], "was started")

2336: Pump stopped
([to], [from], "reports", [system], "pump", [num1], "was stopped")

2341: Compartment flooded
([to], [from], "reports compartment", [compartment], "was flooded")

2342: System activated
([to], [from], "reports", [system], "was activated in compartment", [compartment])

2345: System secured
([to], [from], "reports", [system], "is secured in compartment", [compartment])

2351: Compartment overhauled
([to], [from], "reports compartment", [compartment], "has been overhauled")

2352: Compartment dewatered
([to], [from], "reports compartment", [compartment], "has been dewatered")

2353: Compartment desmoked
([to], [from], "reports compartment", [compartment], "has been desmoked")

2362: Casualty power routed
([to], [from], "reports casualty power has been routed from", [num1], "to", [num2])

2363: Casualty power has been energized
([to], [from], "reports casualty power has been energized")

2391: Fire is out
([to], [from], "Fire is out in compartment", [compartment])

2392: Reflash watch is set
([to], [from], "Reflash watch is set in compartment", [compartment])

2400: Negative outcome reports for orders

2401: Problem out of control
([to], [from], "reports", [problem], "out of control in compartment", [compartment])

2405: Compartment could not be accessed
([to], [from], "reports compartment", [compartment], "could not be accessed")

2406: Compartment could not be evacuated
([to], [from], "reports compartment", [compartment], "could not be evacuated")

2411: No personnel available
([to], [from], "reports", "no personnel available to handle request")

2415: Pipe cannot be patched
([to], [from], "reports", [system], "pipe in compartment", [compartment], "cannot be patched")

2416: Walls could not be patched
([to], [from], "reports walls in compartment", [compartment], "cannot be patched")

2421: Boundaries could not be set
([to], [from], "reports", [problem], "boundaries could not be set")

2425: Compartment could not be isolated
([to], [from], "reports", [status], "isolation of compartment", [compartment], "failed")

2431: Valve could not be opened

([to], [from], "reports", [system], "valve", [string1], "could not be opened")

2432: Valve could not be closed
([to], [from], "reports", [system], "valve", [string1], "could not be shut")

2435: Pump could not be started
([to], [from], "reports", [system], "pump", [num1], "could not be started")

2436: Pump could not be stopped
([to], [from], "reports", [system], "pump", [num1], "could not be stopped")

2441: Compartment could not be flooded
([to], [from], "reports compartment", [compartment], "could not be flooded")

2442: System could not be activated
([to], [from], "reports", [system], "could not be activated in compartment", [compartment])

2445: System could not be secured
([to], [from], "reports", [system], "could not be secured in compartment", [compartment])

2451: Cannot overhaul compartment
([to], [from], "reports compartment", [compartment], "cannot be overhauled")

2452: Compartment cannot be dewatered
([to], [from], "reports compartment", [compartment], "cannot be dewatered using", [string1])

2453: Compartment cannot be desmoked
([to], [from], "reports compartment", [compartment], "cannot be desmoked using", [string1])

2462: Casualty power could not be routed
([to], [from], "reports casualty power could not be routed from", [num1], "to", [num2])

2463: Casualty power could not be energized
([to], [from], "reports casualty power could not be energized")

2491: Fire has reflashed
([to], [from], "reports fire has reflashed in compartment", [compartment])

2500: Requests

2501: Request MR/Z report
([to], [from], "requests status of manned and ready and zebra set throughout the ship")

2600: Responses to requests

2635: Grant permission to start pump
([to], "permission granted to start", [system], "pump", [num1])

2636: Deny permission to start pump

([to], "permission denied to start", [system], "pump", [num1])

2641: Grant permission to flood compartment
([to], "permission granted to flood compartment", [compartment])

2642: Deny permission to flood compartment
([to], "permission denied to flood compartment", [compartment])

2653: Grant permission to desmoke compartment
([to], "permission granted to desmoke compartment", [compartment], using [string1])

2654: Deny permission to desmoke compartment
([to], "permission denied to desmoke compartment", [compartment], "using", [string1])

2662: Grant permission to route casualty power
([to], [from], "grants permission to route casualty power from", [num1], "to", [num2])

2663: Grant permission to energize casualty power
([to], [from], "grants permission to energize casualty power")

2668: Deny permission to route casualty power
([to], [from], "denies permission to route casualty power from", [num1], "to", [num2])

2669: Deny permission to energize casualty power
([to], [from], "denies permission to energize casualty power")

2800: Announcements

2801: Station MR/Z status
([to], [from], "reports", [status])

2702: System MR/Z status
([to], [from], "reports", [status], "on", [system])

2805: Personnel available
([to], [from], "reports personnel available")
Only issued after a previous "No personnel available" message

2811: Alarm in compartment
([to], [from], "reports", [alarm], "alarm in compartment", [compartment])

2812: Alarm on system
([to], [from], "reports", [alarm], "alarm on", [adjective], [system])

2815: Alarm reset in compartment
([to], [from], "reports", [alarm], "alarm reset in compartment", [compartment])

2816: Alarm reset on system
([to], [from], "reports", [alarm], "alarm reset on", [adjective], [system])

2821: Compartment status
([to], [from], "reports", "compartment", [compartment], "is", [status])

2822: System status
([to], [from], "reports", [adjective], [system], "is", [status])

2823: Pump status
([to], [from], "reports", [system],"pump", [num1], "is", [status])

2824: Valve status
([to], [from], "reports", [system], "valve", [string1], "is", [status])

2825: Pipe rupture
([to], [from], "reports rupture on", [adjective], [system], "in compartment", [compartment], "at frame", [num1])

2826: Wall (wall) rupture
([to], [from], "reports wall rupture in compartment", [compartment], "at frame", [num1])

2831: System pressure
([to], [from], "reports", [status], "pressure", "on", [adjective], [system])

2832: Coordinating the realignment of
([to], [from], "reports coordinating the realignment of", [system])

2833: System result
([to], [from], "reports", [system], [status], "in compartment", [compartment])

2862: Electrical power lost
([to], [from], "reports loss of electrical power to", [num1])

2863: Electrical power restored
([to], [from], "reports electrical power to", [num1], "has been restored")

2871: Rig MOPP level
([from], "orders rig", [string1], "MOPP level", [num1])

2881: Water level rising
([to], [from], "reports", "water level", "in compartment", [compartment], "is", [num1], "inches {pause} rising", [num2], "inches", "per minute")

2890: General Quarters
("general quarters")

2891: Time since GQ
([from], "reports gq plus", [num1])

2892: Zebra set time
([from], "reports zebra set throughout the ship at gq plus", [num1])

2895: Primary damage event
([problem])

2896: Casualty report
([to], [from], "reports", [num1], "casualties in compartment", [compartment])

2897: Ship saved
("Ship saved")

2898: Ship lost
("Ship lost because", [string1])

2899: Abandon ship!
("abandon ship")

9000: Internal simulator messages

9100: Time synchronization and flow control

9101: Minutes since GQ
[num1] is number of minutes since GQ set

9102: Seconds since GQ
[num1] is number of seconds since GQ set

9105: New time scaling factor
[num1] is current sim time in seconds; [num2] is new time scaling factor * 100

9110: Begin simulation

9111: Pause simulation

9112: Resume simulation

9113: Stop simulation

9120: Call GQ
Sets zero point for simtime.

9200: Communication between agents and simulator

9201: Dynamic table updated by agents
[string1] is table name; [num1] is serial number of updated entry

9202: Dynamic table updated by simulator
[string1] is table name; [num1] is serial number of updated entry

9211: Fighting fire
[num1] is compartment serial number; [string1] is fire-fighting medium; [num2] represents strength (number of 'doses') of fighting

9212: Flooding compartment
[num1] is compartment serial number

9213: Draining compartment
[num1] is compartment serial number

9214: Mechanically isolating compartment
[num1] is compartment serial number

9215: Electrically isolating compartment
[num1] is compartment serial number

9216: Overhauling compartment
[num1] is compartment serial number

9231: Ventilate (desmoke) compartment
[num1] is compartment serial number

9232: Secure (stop) ventilation in compartment
[num1] is compartment serial number

9900: Miscellaneous messages

9901: User logon
[string1] is user ID

10000: Behind-the-scenes messages & signals

10001: Ignite compartment (Temporary hack for primary damage)
[num1] is compartment serial number

10002: Flood compartment (Temporary hack for primary damage)
[num1] is compartment serial number

12000: "God mode" agent-like reports and commands

12821: "God mode" status report from sim
[compartment] is KBS compartment ID; [status] is new status

10. Future Communication Ideas

Intermodule communication is one of the most important aspects of having a system that functions well. When sensor data come in, certain modules want to know about those changes while others do not need to hear about it. When important changes to the state of the ship occur, those changes need to be propagated to the different modules and each module deals with those changes in their own unique way. Furthermore, some modules simply need to send messages to one another for a variety of reasons.

Currently the event communication is handled through the database. This provides a common place for all modules to look for messages and to send messages of their own. While this implementation suffices, there are certain problems that come with it that could be solved. At some point in time, all modules need to frequently check this table for new communications, which was one of the first signs of a design flaw. This problem was fixed by implementing triggers, which upon a new row insertion could immediately let any module know that there is a new communication. By eliminating the need for each module to poll the database, the database activity lessened greatly and each module had a much more simplified process for communicating with each other. There are some stipulations to using triggers. however. Not every module could receive triggers in the same way, which added complexity to the use of triggers making it desirable for some form of direct communication between modules without use of the database.

It would be ideal for communication between modules to occur just as human communication occurs: when a message needs to be conveyed, the simplest way to do so is to directly communicate the message with sender and recipient. In the situation of event communication in our system, this would be a fast and efficient way to handle the problem. The idea to implement communications deals with having a centralized communication module, similar to the database, but since its purpose would be for communication it could more intelligently deal with each module and the messages that need to be sent between them.

With this event communicator any module that would want to hear about a particular event would subscribe, in a sense, to that event. Then, in the same way that each module would deal with a particular ECL message that is received, the event communicator would, upon getting the signal from one module to propagate a message, send this message to any other module that is subscribing to this event. It is fast, simple, direct communication that does not require the overhead of interpreting a generically formatted message.

There are some design issues with making this centralized communicator. First and most important is that it is not a generically formatted message, which means that modules would be directly connected into the central communicator. Also the organization of such a module is fairly complicated and would have to take into account any kind of communication that would be desired by any module. The most promising part of this design idea is that it would be direct and unified communication. Also there would be many improvements in the speed of communication. Not having to interpret a generically formatted message, or go through the database, or have to wait on a trigger will make event reactions happen faster. Overall as a design idea, it is completely different from the currently implemented database event communication language, and it would provide the system with the fastest possible means of communication.

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